PHY 115

1. Which of the following thermometer would be most suitable for supply fluctuating temperature;
   a) Constant volume gas
   b) Mercury in glass
   c) Thermoelectric
   d) Platinum resistance

2. The values of the pressure and volume of a fixed mass of gas in gas thermometer at the triple point of water are $P_{tr} = 1.00 \times 10^5 Pa$. V_{tr} $1.00 \times 10^3 m^3$. When the pressure of gas is 1.10×10^5 Pa and its volume is $1.20 \times 10^3 m^3$. What is the temperature of the gas
   a) 250k   b) 273k   c) 298k   d) 361k

3. Which of the following physical properties cannot be used to measure temperature?
   a) The change in pressure of a gas at constant volume
   b) Area expansion of a column of mercury
   c) Volume of an ideal gas
   d) The resistance of a piece of conductor

4. The flow of blood in the body of a human being is typical example of
   a) convection   b) radiation   c) conduction   d) evaporation

5. The rate at which a body emits radiant energy is proportional to the following factors except
   a) Absolute temperature
   b) fourth power of absolute temperature
   c) length of the body
   d) surface area of the body

6. Which of the following statement is not correct about an ideal absorber
   a) emissivity e>1   b) emissivity e<1
   c) emissivity e=0   d) emissivity=1

7. Which of the following particles transport thermal energy through solids such as crystals?
   a) free electrons   b) photons   c) protons   d) ions

8. Which of the following defines kinetic temperature?
   a) $mv^2 \frac{m\bar{v}^2}{3k_B}$ b) $\frac{1}{2} \frac{m\bar{v}^2}{k_B}$ c) $\frac{2m\bar{v}^2}{3k_B}$ d) $\frac{3m\,v^2}{2k_B}$

9. A fixed mass of an ideal gas slowly absorbs 1000J of heat and expands slowly at constant pressure of 2.0×10^4 Pa from a volume of $0.050m^3$ to a volume of $0.075m2$. What is the effect of the internal energy on the gas?

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a) It decreases by 1000J
b) It decreases by 500J
c) It increases by 500J
d) It is unchanged.

10. Which of the following is true about isothermal process?
a) Work $\Delta W = -nRT\ln(v_i/v_f)$
b) If $\Delta W \leq E$, work is done on the gas by the environment
c) $\Delta Q < 0$, heat flows out of the gas
d) $\Delta Q > 0$, heat flows out of the gas

11. When work is done by or on a system at constant pressure
a) ΔV is negative, expansion
b) ΔW is positive, expansion
c) ΔV is positive, compression
d) ΔW is positive, compressing

12. A sheet of rubber and a sheet of cardboard each 2mm thick are pressed together and their outer focus are maintained respectively at 0°C and 25°C. If the thermal admissives of rubber and cardboard are 0.13 and 0.05Wm⁻¹L-1. Estimate the temperature of the interface
a) 0°C   b) 7°C   c) 13.50°C   d) 250°C

13. The equation $\frac{dQ}{dt} = KA\frac{dQ}{dx}$ gives the rate of heat transfer through a conductor has an electrical equipment based on ohm's kw. When making the comparison, which of the following is/are correct?
i) $\frac{dQ}{dt}$ is analogous to the current
ii) $\frac{dQ}{dx}$ is analogous to the potential difference
iii)   K is analogous to the resistivity
a) i only   b) iii only   c) i and ii only   d) i, ii and iii

14. The most probable energy in Maxwell's energy distribution is
a) $^3/_2$ K_{BT} b) $\frac{1}{2} K_{BT}$ c) $^1/_3 K_{BT}$ d) $^3/_2 K_{BT}$

15. What is the average kinetic energy of molecules on a gas at 37°C?
a) 2.14×10^{-21}J b) 4.28×10^{-21}J c) 6.42×10^{-21}J d) 6.75×10^{-21}J

16. The quantity which cannot be used to specify the state of thermodynamic system is
a) Internal energy   b) entropy
c) chemical potential   d) temperature

Use the information below to answer questions 17 – 19.
A quantity of ideal gas occupies an initial volume V₀ at a pressure P₀ and a temperature T₀. It expands to a volume Vᵢ.

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i)   At constant pressure
ii) At constant temperature
iii) A diabotically

17. In which case is Q greatest? Least?
   a) i and ii   b) i and iii   c) iii only   d) i only
18. In which case is W greatest? Least?
   a) i only   b) ii and iii c) iii only   d) i and iii
19. In which case is ΔU greatest? Least?
   a) Ii only   b) iii only   c) i and iii d) ii and iii
20. Which of the following is not true for equation of a reversible adiabatic expansion of an ideal gas?
   a) $TV^{\delta-1}$ = constant   b) PV^{δ} = constant
   c) $P^{\delta-1}/T^2$ = constant   d) $PV^{\delta-1}$ = constant
21. The thermal efficiency of the carrot engine assuming that the working substance in an ideal gas is
   a) $Q_H/(Q_H - Q_L)$ b) W/Q c) $1 - (T_H/T_L)$ d) $(Q_H - Q_L)/Q_H$
22. What is the root mean square velocity of nitrogen at a temperature of 20°C
   a) $133ms^{-1}$ b) $169ms^{-1}$ c) $293ms^{-1}$ d) $510ms^{-1}$
23. Calculate the amount of heat required to raise the temperature of $600cm^3$ of water from 40°C to boiling point at 100°C. Density of water is $100kg/m^{-3}$ and specific heat is 4200J/kg.k
   a) $1.512 \times 10^{11}J$ b) 151.2kJ   c) 500J   d) 610kJ
24. A rail made of iron is 12.00m long at 0°C. What is its length when heated to boiling point of water? Coefficient of linear expansion of iron is $1.2 \times 10^{-5}k^{-1}$
   a) 12.0144m   b) 18.04m   c) 12.14m   d) 12.08m
25. A black body of surface area 2.5×10^{-2} m^{δ} and at temperature 2000°C is placed in a room where the temperature is 30°C. Calculate the net rate of heat radiation in the body.
   a) $31825.4Js^{-1}$ b) $40025.6Js^{-1}$ c) $8275.4Js^{-1}$ d) $39285.4Js^{-1}$

Use the reformations below to answer questions 26 – 28.
3 moles of an ideal gas is kept at 8.0oC during an expansion from 7.5 litres to 15.51 litres. How much work is done by the gas during the expansion?
26. 2087.88J   b) 3089.88J   c) 4087.88J   d) 5087.88J
27. How much energy transfer by heat occur with the surroundings in the process?
28. If the gas is returned to its original volume by Isobaric process, how much work is done by the gas?

Use the information below to answer questions 29 – 31.

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1 mole of hydrogen gas is heated at constant pressure from 300k to 420k.
calculate

29. The energy transferred by heat to the gas?
    a) 0J   b) 3491.88J   c) 2494.2J   d) 997.68J

30. The increase in its internal energy
    a) 0J   b) 2494.2J   c) 3491.88J   d) 997.68J

31. Work done by the gas
    a) 0J   b) 2494.2J   c) 3491.88J   d) 997.68J

32. At what temperature will celcius and Fahrenheit scale have the same reading?
    a) -40°   b) 40°   c) -60°C   d) 20°

33. A glass window having a coefficient of linear expansion 3.2×10^{-6} is exactly 20cm by 30cm at 10°C. By how much is its area increased when its temperature is 40°C?
    a) 0.02545m²   b) 1.2m²
    c) 1.152×10^{-5}m²   d) 1.285×10^{-5}m²

34. An ideal gas occupies a volume of 100cm³ at 20°C and 100Pa. find the number of moles in the container.
    a) 2.73×10^{-6}moles   b) 2.73×10^{-5}moles
    c) 8.5moles   d) 2.4moles

35. In question 34 above find the number of molecules in the container.
    a) 1.647×10^{18} b) 2.4×10^{18}
    c) 3.6×10^{18} d) 1.06×10^{18}

36. In an experiment with a constant volume gas thermometer the pressure at the triple point of water was found to the 4.0×10^{4}Pa. what is the temperature of absolute zero on celcius scale?
    a) 368.8k   b) 468.8°C   c) 368.8°C   d) 468.8k

37. The resistance of the element of a platinum resistance thermometer is 2.00Ω at the ice point and 2.73Ω at the steam point. What temperature on the platinum resistance scale would correspond to a resistance value of 8.43Ω?
    a) 881°C   b) 481k   c) 881k   d) 481°C

38. Which thermometer temperatures are used as standard temperatures?
    a) Gas thermometer   b) electric thermometer
    c) resistance thermometer   d) thermocouples

39. Two-moles of helium gas is at a pressure of 20Pa and internal equilibrium with an unknown gas. If the unknown gas is at a temperature of 70°F. Find the volume of the helium gas
    a) 2445   b) 24.45   c) 2.445   d) 244.5

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40. Compute the number of molecules in a volume of 5cm³ at a temperature of 500k and a pressure of 1cm of mercury
   a) 7.3×10^{22}
   b) 0.73×10^{22}
   c) 73×10^{22}
   d) 0.073×10^{22}

$Q = n(c_p) \Delta$

$c_p = \frac{5}{2} + ?$

5

PHY 115

1. Find the force associated with the expansion of steel beam whose cross-sectional area is $250cm^2$ when its temperature increases by $20°C$ (Yung Modulus for steel $r = 2.0 \times 10^{11}N.m^2$ and coefficient of linear expansitivity $\alpha = 1.2 \times 10^{-5}/°C$)

Use the information below to answer questions 2 and 3.

A gas sample occupies $4.3m^3$ at an absolute pressure of 2 bar and a temperature of 320k

2. find its volume at temperature of 400k if the pressure remains 2 bar
   a) $5.0m^3$ b) $21.0m^3$ c) $20.0m^3$ d) $15.0m^3$

3. Find its volume at 320k temperature and a pressure of 0.4bar.
   a) $5.0m^3$ b) $20.0m^3$ c) $6.0m^3$ d) $15.0m^3$

4. Heat transfer by convection occurs
   a) Only in liquids
   b) Only in gases
   c) Only in liquids and gases
   d) In solids, liquids and gas

5. The temperature of an object that emits electromagnetic radiation must be
   a) Higher than that of its surroundings
   b) Higher than $0°C$
   c) Higher than 0k
   d) High enough for it to glow

6. Heat flows through a wooden board 30mm thick at $0086Wcm^{-2}$ when one of its sides is $20°C$ warmer than the other. What is the thermal conductivity of the wood?
   a) $0.013W/(m_1°C)$ b) $0.78W/(m_1°C)$
   c) $0.52W/(m_1°C)$ d) $0.13W/(m_1°C)$

Use the information below to answer questions 7 – 9.

A mass of gas at an initial pressure of 28 bars with an internal energy of 1500kJ is contained in a well insulated cylinder of volume $0.6m^3$. The gas is allowed to expand behind the piston until its internal energy is 1400kJ. The law of expansion $PV^2 = constant$.

7. What is the work done by the gas?
   a) 200kJ   b) 100kJ   c) -100kJ   d) -200kJ

8. What is the final volume of the gas?
   a) $14.8m^3$ b) $0.15m^3$ c) $4.50m^3$ d) $2.0 \times 10^{-3}m^3$

9. Calculate the final pressure of the gas
   a) 4.59 bar   b) 14.0 bar   c) 56 bar   d) 45.9 bar

10. When will molecular motion in a gas stop?
    a) When the gas becomes a liquid

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b) When the gas becomes solid
c) At absolute zero
d) When the pressure on it exceeds a certain volume

11. An aluminium pot whose volume is 100cm3 of 20oC has a volume of 100cm³ at 100°C. The coefficient of linear expansion of aluminium is
a) 2.25 x 10^{-4}/°C
b) 7.5 x 10^{-5}/°C
c) 6.0 x 10^{-3}/°C
d) 2.5 x 10^{-5}/°C

12. When an iron bar is heated from 283k to 383k, which of the following statement is correct?
a) Its volume increase and its density decreases
b) Its volume increases and its density is uncharged
c) Its volume increase and density increases
d) Its volume is unchanged and its density increases

13. The temperature of gas in a container of fixed volume is raised. The gas exerts a higher pressure on the walls of the container because
a) Loose more P.E when they strike the walls
b) Loose more K.E when they strike the walls
c) Are in contact with the walls for a short time
d) Have higher average velocities and strike the walls more often.

14. The volume of a gas sample in a container is increased while its temperature is held constant. The gas exerts lower pressure on the walls of the container partly because its molecules strike the walls
a) With less energy
b) less often
c) with less force
d) with lower velocities

15. The molecules of a gas at 10°C would have twice as much average kinetic energy at what temperature?
a) 566°C
b) 859°C
c) 20°C
d) 293°C

16. When a heat engine takes in heat at one temperature which of the following is true?
a) It turns all the heat into work
b) It turns some of the heat into work and rejects the rest at a higher temperature
c) It turns some of the heat to work and rejects the rest at a lower temperature
d) It turns some of the heat to work and rejects the rest at the same temperature

17. If a correct engine absorbs 10kJ of heat per cycle when it operates between 500k and 400k. what is the amount of work done per cycle?
a) 2.5kJ
b) 2kJ
c)) 8kJ
d) 10kJ

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18. Three designs A, B and C for an engine to operate 500k and 300 are proposed. Design A is calculated to be 750J, design B t produce 500kJ and design C to produce 250J of work per kilojoul of heat input. Which design has the highest efficiency?
    a) C   b) A   ,   c) B   d) None

19. A blackbody is at a temperature of 500oC. What is its temperature in order that it radiates twice as much energy per second?
    a) 564oC   b) 464oC   c) 646oC   d) 746oC

20. The temperature of the earth's surface average at 15oC. If the earth were a black body, at what rate would it radiate energy?
    a) 288W/m²   b) 390 W/m²   c) 251 W/m²   d) 79 W/m²

21. The bare skin of a boy is at an average temperature of 33oC in a room of temperature 20oC. If the emissivity e = 1, calculate the net rate of which the boy loss energy by radiation.
    a) 0.16µW/cm²   b) 79mW/cm²
    c) 50mW/cm²   d) 89W/cm²

22. The temperature difference between the inside and the outside of an automobile engine is 450oC. This temperature difference in Kelvin scale is
    a) 450k   b) 743k   c) 197k   723k

23. Find the minimum amount of ice at -10oC needed to bring the temperature of 500g of water at 20oC to 0oC
    a) 118g   b) 218g   c) 1992.4g   d) 0.118g

24. Which of the following statement is/are correct?
    i) Temperature is a scalar quantity
    ii) Temperature is describes by a number
    iii) The gas pressure of a gas at covalent pressure can be used as a thermometric property
    iv) Zeroeth law of thermodynamics enables us to defeat energy
    a) i and iv   b) ii   c) iv   d) iii

25. Which of the following is/are correct?
    i)   Work done by a system depends on its initial and final state
    ii)   'work done by a system dependis only on the path followed by the system
    iii)   A cyclic process starts and ends at same state
    iv)   Adiabatic process starts and ends at the same state.
    a) ii and iii only   b) i, ii and iv only
    c) i and iv only   d) i only

26. fifteen molecules of a gas have speeds of 60, 90, 10.0, 13.0, 13.0, 15.0, 17.0, 17.0, 18.0, 19.0, 20.0, 20.0, 22.0, 23.0, 24.0 all in ms⁻¹. What is the root mean square speed?
    a) 15.3ms⁻¹   b) 17.2ms⁻¹   c) 16.ms⁻²   d)18.6ms⁻¹

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27. A hot liquid at 80°C is added by 600g of the same liquid originally at 10°C. When the mixture reaches 30% the total mass of the mixture is

a) 825g   b) 240g   c) 840g

e) inadequate information since the specific heat is not given

Use the following information to answer questions 28 – 30

A 10KW refrigerator whose coefficient of performance (COP) is 2.0 takes heat from a freezer compartment at -20°C and exhausts it at 40°C

28. What is the COP if it is an ideal refrigerator?

a) 2.4   b) 4.2   c) 5.2   d) 3.2

29. At what rate would the refrigerator remove heat from the freezer compartment

a) 2.0KW   b) 4.2KW   c) 5.2KW   d) 2.4KW

30. What is its percentage of COP relative to that of an ideal refrigerator?

a) 50%   b) 40&   c) 48%   45%

Use the following information to answer questions 31 and 32

Two moles of an ideal gas (r = 1.40) expands slowly and initially from pressure of 5.00atm and volume 12.0m³ to final volume of 30.0m³

31. What is the final pressure of the gas?

a) 3.00 atm   b) 2.00 atm   c) 1.39atm   d) 0.50 atm

32. What is the initial temperature?

a) 366.4K   b) 286K   c) 3.6K   d) 253.5K

33. Which of the following statement is/are correct? Without work being done on it, gas cannot be

i)   Compressed adiabatically
ii)   Compresses isothermally
iii)   Compresses adiabatically
iv)   Expanded adiabatically

a) i and ii only   b) iv only   c) ii and iii only   d) i, ii and iii

Use the following information to answer questions 34 and 35

an ideal gas initially at 300k undergoes an isoberic expansion at 2.50kPa. the volume increases from 1.00m³ to 3.00m³ while 12.5kJ of energy is transfers to the as by heat.

34. What is the change in internal energy of the gas?

a) 5.70kJ   b) 2.50kJ   c) 12.5kJ   d) 7.5okJ

35. What is the final temperature?

a) 900K   b) 400K   450K   d) 490K

36. What is the real mean square speed of oxygen at 14°C?

a) 14.45ms⁻¹   b) 472.96ms⁻¹
c) 21.15ms⁻¹   d) 668.87ms⁻¹

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37. Which of the following statement is untrue about an ideal gas?
   a) P.E of their molecular interaction is negligible compared with the K.E of their notion
   b) Intermolecular forces between the molecules are strong
   c) Internal energy is a function of the temperature of the gas
   d) The collision of the molecules is elastic

38. Which of the following thermometers can be sued to measure a constantly changing temperature?
   a) Thermoelectric thermometer
   b) measuring glass
   c) constant-volume gas
   d) platinum resistance

39. Which of the following thermodynamic variable is not intensive variable?
   a) Specific heat
   b) density
   c) head content
   d) temperature

40. A thermodynamic system whereby only energy is allowed to move across the boundary is termed
   a) Isolated system
   b) closed system
   c) open system
   d) open or closed system